

Line Haul Tug M/V Klihyam Low-NO_x Repower Project



Prepared for: BHP Billiton Cabrillo Port Offshore LNG Terminal

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M/V KLIHYAM REPOWER PROJECT

Background

BHP Billiton LNG International, Inc. (BHP) is proposing to build a LNG importation terminal located in Federal waters approximately 14 miles off the Coast of Ventura County. The terminal consists of a Floating Storage and Regasification Unit (FSRU) which is used to store and vaporize liquefied natural gas (LNG). LNG delivered from LNG carriers is offloaded to the FSRU, stored until needed and then regasified. Gas is then transported via two parallel 24-inch pipelines to an onshore facility at Ormand Beach near Oxnard in Ventura County. The project location is 2.06 nautical miles from the edge of shipping channel.

BHP has offered to mitigate the proposed project's NOx emissions by funding engine conversions for third party marine vessels operated along the California Coast. This report identifies one of these vessels, the M/V Klihyam, and documents the anticipated emission reductions as a result of the engine repowering as well as the areas where the anticipated emission reductions are expected to occur.

Proposed Mitigation Project

Project

Repower the line haul tug boat M/V Klihyam operated by Sause Brothers, Inc. with low-NOx engines.

M/V Klihyam Details

M/V Klihyam details are as follows:

Official number	1084928
Gross tonnage	197
Net tonnage	134
Length	114' 9.5"

M/V Klihyam Baseline (i.e., Existing) Engines

The M/V Klihyam utilizes two engines for propulsion. Both are Electro-Motive Diesel (EMD) 16-645E6 engines which generate 1,950 h.p. at 900 rpm. The model numbers for each engine are stated below:

S/N Port 81-H1-1055, MY 1981
S/N Starboard 82-M2-1008, MY 1982

The first two digits in the serial number reflect the model year for the engine (e.g. the 81-H1-1055 is a 1981 engine).



Project Description

Sause Brothers, Inc. uses the line haul tug M/V Klihyam primarily to tow the barge Sunset Bay from Richmond to Los Angeles. References to Los Angeles are intended to also include Long Beach and El Segundo. The vessel also occasionally makes trip into Martinez, Benicia, and San Francisco. Sunset Bay barge hauls petroleum products and is equipped with a vapor recovery system. Sunset Bay generators and engines already comply with USEPA Tier II emission limits.

Sause Brothers took over this line haul run in December 2004 and began operation on December 28, 2004. Prior to Sause operation, the service was being provided by Crowley Maritime. Sause Brothers is using the M/V Klihyam for this operation with a combined total horsepower of 3,900.

Engine Repower

The engine repower project consists of replacing M/V Klihyam's existing diesel propulsion engines (dual EMD16-645E6 engines) with new low-emissions EMD8-710G7B diesel propulsion engines. The 8-710G7B engines are rated at 2,000 h.p. each at 900 rpm. 8-710G7B engines are electronically controlled while the 16-645E6 engines are mechanically controlled. The electronic controls ensure more precise operation and lower emissions per brake horsepower-hour (bhp-hr). Additionally 8-710G7B engines

are more fuel efficient compared to the existing 16-645E6 engines. Information regarding the EMD 8-710 engines, as well as information about the current configuration of the M/V Klihyam is included in Attachment E.

Emission Reduction Calculations and Documentation

a. Historical Operation

M/V Klihyam began operation on December 28, 2004, towing petroleum barge Sunset Bay. Therefore, the evaluation of operating history is limited to this time as the previous route operator's records are not available for inspection. The review consisted of both reviewing the fuel logs and reviewing the trip logs.

The fuel logs document that in 12 months period (3/10/05 – 3/10/06) a total of 548,142 gallons of diesel was burned in M/V Klihyam, excluding the 3/10/06 fill. The Sause Brothers fuel logs are included in Attachment F. A summary of the fuel logs is presented in Section D of Attachment A.

The trip logs document that M/V Klihyam took a total of 291 trips. Of this total, 49 were line haul trips (inter-coastal), 157 trips occurred locally within the Los Angeles, El Segundo and Long Beach area, and 85 trips occurred locally within the Richmond, San Francisco, Martinez, Benicia, and Rodeo area. Copies of the actual trip logs are included in Attachment B and a summary of the trip routes, along with distances and trip time, are presented in Section E of Attachment A.

b. Emission Reduction Calculation Formula

In order to calculate the emission reductions attributable to the M/V Klihyam engine repower, OceanAir utilized the equation memorialized in South Coast AQMD Rule 1631(f). Rule 1631 established a program for the generation of mobile source emission reduction credits (MSERCs) through the repowering of diesel-fueled marine vessels. This rule was the subject of prolonged discussion between US EPA Region 9, South Coast AQMD and various stakeholders. This effort generated a rule that took into account multiple perspectives while ensuring a reasonably conservative means of MSERC calculation. This rule has been approved by EPA as part of the California State Implementation Plan. As a result, Rule 1631 is uniquely appropriate for the calculation of the anticipated emission reductions attributable to this marine engine repower project.

Consistent with Rule 1631, the emission reductions attributable to the repowering of M/V Klihyam were quantified using the following equation:

$$ER_{Klihyam} = (EF_{base} - EF_{repower}) \times ECF \times \text{Fuel Burn} / 454/2000$$

Where:

$$EF_{base} = \text{Baseline Emission Factor (gms/bhp-hr)}$$

$$\text{EF}_{\text{repower}} = \text{Repower Emission Factor (gms/bhp-hr)}$$

$$\text{ECF} = \text{Energy Consumption Factor (bhp-hr/gal)}$$

The basis for each of these variables is explained below.

c. Baseline Emission Factor (EF_{base})

The baseline emission factor for NOx was taken from 1992 emissions information by EMD, the engine manufacturer, for the 16-645 roots blown engine type. A copy of this specification sheet is included as Attachment C. The PM emission factor was taken from off-road default information for the model year.

d. Repower Emission Factor ($\text{EF}_{\text{repower}}$)

The repower emission factors were based on the Tier 2 emission limits. As documentation of compliance with these limits, OceanAir has included as Attachment D EMD's Certificate of Conformity.

e. Energy Consumption Factor (ECF)

The Energy Consumption Factor was derived from information in the EPA 2006 Model Year Certificate of Conformity. Specifically, the brake specific fuel consumption (bsfc) is identified in the Certificate of Conformity Propeller Cube Curve as 0.314 lb/bhp-hr at 900 rpm. At a fuel density of 7.1 lb/gallon, the ECF calculates to 22.61 bhp-hr/gal. This calculation is shown in Section C of Attachment A.

f. Emission Reduction Calculations

Based on the formula and variables identified above, OceanAir calculated the emission reductions anticipated to result from the repowering of the M/V Klihyam. Details for this calculation are shown in Section C of Attachment A. In total, it is projected that as a result of the M/V Klihyam engine repower project NOx emissions in California Coastal Waters will be reduced by 138.69 tons per year and that particulate emissions will be reduced by 4.52 tons per year. Emission reductions by segment and by air district are presented in Sections C.1 and C.2 of Attachment A.